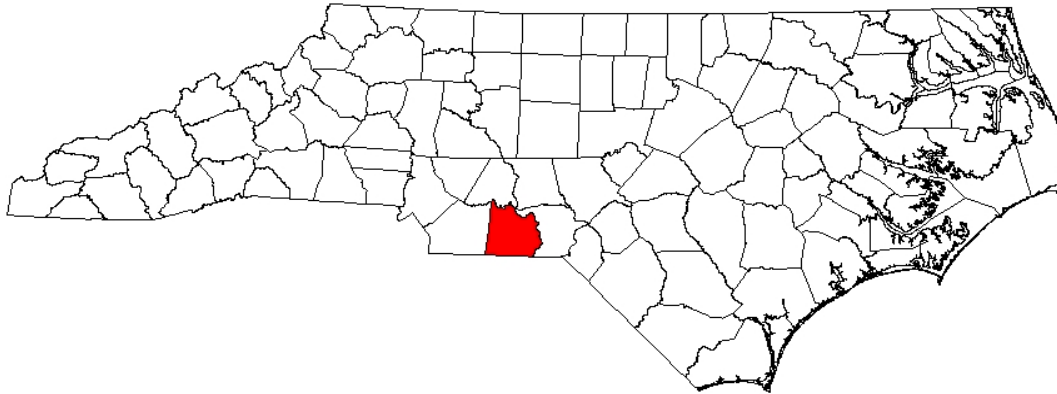


ANNUAL REPORT FOR 2004



Key Branch Mitigation Site
Anson County
WBS Element 34398.4.1
TIP No. R-2239WM



Prepared By:
Office of Natural Environment & Roadside Environmental Unit
North Carolina Department of Transportation
March 2005

Summary

The following report summarizes the stream monitoring activities that have occurred during the Year 2004 at the Key Branch Mitigation Site in Anson County. This site was designed and constructed during 2003 by the North Carolina Department of Transportation (NCDOT) to provide mitigation for stream impacts associated with Transportation Improvement Program (TIP) number R-2239WM in Anson County. This report provides the monitoring results for the first formal year of monitoring (Year 2004). The Year 2004 monitoring period was the first of five scheduled years for monitoring on Key Branch.

Based on the overall conclusions of monitoring, the Key Branch Mitigation Site has met the required stream monitoring protocols for the first formal year of monitoring. Higher than normal water levels exist due to a beaver impoundment at the lower end of the reach; however, NCDOT is in contact with the United States Department of Agriculture (USDA) to remove the impoundment and relocate the beavers.

Based on information obtained from the USGS, the Key Branch Site has not met the required hydrologic monitoring protocols; however, four years of hydrologic monitoring remain for the site to meet these protocols. The North Carolina Department of Transportation will continue hydrologic monitoring at the Key Branch Site for 2005. Vegetation monitoring and wetland monitoring are also being conducted by NCDOT as part of a separate report. Biological data was not required for this site. Biological sampling was not required as part of the monitoring success criteria for this site.

Per the letter from the Ecosystem Enhancement Program (EEP) to NCDOT dated August 25, 2004, the EEP has accepted the transfer of all off-site mitigation projects. The EEP will be responsible for fulfilling the remaining monitoring requirements and future remediation for this project.

1.0 INTRODUCTION

1.1 Project Description

The following report summarizes the stream monitoring activities that have occurred during the Year 2004 at the Key Branch Mitigation Site. The site is located between Lower White Store Road (SR 1252) and Mineral Springs Church Road (SR 1240) in Anson County, North Carolina (Figure 1). It is approximately 7 miles (11 kilometers) southeast of Marshville, NC and 12 miles (20 kilometers) southwest of Wadesboro, NC.

The mitigation project covers approximately 6,200 linear feet of channel length (facing downstream) of Key Branch. Design and construction was implemented during 2003 by the North Carolina Department of Transportation (NCDOT). Stream restoration involved the installation of rootwads and various rock structures, and sloping the adjacent streambanks to reduce overall erosion. It also included the installation of native vegetation.

1.2 Purpose

According to the mitigation plan report (NCDOT, 2001), the objectives for this mitigation site were to re-establish an integrated wetland-stream complex that will restore the ecosystem processes, structure, and composition that were historically present on the site. The following specific objectives were proposed:

- ◆ Restore/preserve bottomland hardwood/swamp hardwood communities,
- ◆ Restore floodplain/wetland interfaces,
- ◆ Restore natural stream channels and drainage patterns,
- ◆ Re-establish wildlife habitat.

Successful stream mitigation is demonstrated by a stable channel that does not aggrade or degrade over time. It is also demonstrated by reduced erosion rates, the permanent establishment of native vegetation, and bed features consistent with the design stream type. Results of stream monitoring conducted in 2004 at the Key Branch Mitigation Site are included in this report.

Activities in 2004 reflect the first formal year of monitoring following the restoration efforts. Included in this report are analyses on stability (primarily the longitudinal profile and cross sections) and site photographs.

1.3 Project History

Fall 2003
Spring 2004
October 2004

Construction Completed.
NCDOT Planted Live Stakes and Bare Root Trees
Stream Channel Monitoring (1 yr.)

2.0 STREAM ASSESSMENT

2.1 Stream Monitoring Requirements

The Key Branch permit conditions state that the development of a monitoring plan will be required for the design reach and would assess geomorphologic and biological parameters in keeping with “Stream Mitigation Guidelines”, dated April 2003. The monitoring plan should include the protocol and provisions for providing reference photographs, channel stability analysis and biological data on a yearly basis. Reference photographs, both longitudinal and lateral, should be taken at least twice a year, preferably in winter and summer and at permanently established locations. Perpendicular transects or cross sections should be permanently established at selected points on the designed reach where channel width, depth, cross-sectional area, and lateral photographs will be collected and provided in the annual monitoring reports. Cross sections shall be established once every 20 bankfull widths and will be divided evenly between riffle and pool bed features. Additional cross sections should be considered for areas where there are structures or other areas where there is a chance of failure.

2.2 Stream Description

2.2.1 Post-Construction Conditions

The mitigation of Key Branch involved the construction of j-hook vanes, log vanes, rock cross vanes, rootwad revetments, step pools, and additional bank sloping. A step pool was installed at the beginning and end of the reach to maintain grade. A rootwad complex was installed in the apex of numerous bends with cover logs for habitat. Cross vanes, log vanes, and j-hook vanes were installed throughout the reach to direct higher flow velocities into the center of the channel. Throughout the entire reach the inner berm was maintained, enhanced, or created as channel modifications were made.

2.2.2 Monitoring Conditions

Key Branch was designed and constructed as a C6 stream type according to the Rosgen Classification of Natural Rivers. Since the construction of Key Branch, a beaver impoundment located approximately 150 feet upstream of the end of the project has caused the water to back up throughout the reach. Due to the abnormally high water level at the time of survey no riffle sections were identified. However, after further interpretation of the profile data it was concluded if the water level was near normal, riffle sections would be present.

Since the permit conditions stipulate placing a cross-section every 20 bankfull widths, a total of twelve cross sections were surveyed. Three cross-sections were identified as riffles, cross-sections 5, 10, and 12. For this report, only cross sections containing riffles were used in the comparison of channel morphology presented below in Table 1. Data shown in Table 1 includes one cross section chosen to represent a riffle section and minimum and maximum values for the riffle cross sections along the reach.

Table 1. Abbreviated Morphological Summary (Key Branch Mitigation Site)

Variable*	Key Branch (Combined Cross Sections #5, 10 and 12)					
	Proposed	2004	2005	2006	2007	
	Min/Max	Cross-Section #5	Min/Max			
Drainage Area (mi ²)	0.97	0.97	0.97			
Bankfull Width (ft)	22 - 25	20.9	20.9 – 26.9			
Bankfull Mean Depth (ft)	0.65 - 0.93	1.0	0.9 – 1.0			
Width/Depth Ratio	27 - 34	20.9	20.9 – 26.9			
Bankfull Cross Sectional Area (ft ²)	17 - 21	20.9	19.0 – 26.9			
Maximum Bankfull Depth (ft)	1.15 - 1.74	1.8	1.6 – 2.1			
Width of Floodprone Area (ft)	>150	150	150			
Entrenchment Ratio	>7	>5	>5			
Slope (%)	.05					
Particle Sizes (Riffle Sections)						
D ₁₆ (mm)	-	<0.062	<0.062			
D ₃₅ (mm)	-	<0.062	<0.062			
D ₅₀ (mm)	Silt/clay	<0.062	<0.062			
D ₈₄ (mm)	-	<0.062	<0.062			
D ₉₅ (mm)	-	1	<0.062 - 1			

* Variables without a Min/Max range indicate no range could be referenced.

2.3 Results of the Stream Assessment

2.3.1 Site Data

The assessment included the survey of twelve cross sections and the longitudinal profile of Key Branch. The constructed length of Key Branch was approximately 6,200 linear feet, however only 5,200 linear feet of the profile was surveyable due to high water levels caused by the beaver impoundment. Twelve cross sections were established during the 2004 monitoring year. Cross section locations were subsequently based on the stationing of the longitudinal profile and are presented below. The locations of the cross sections and longitudinal profiles are shown in Appendix A.

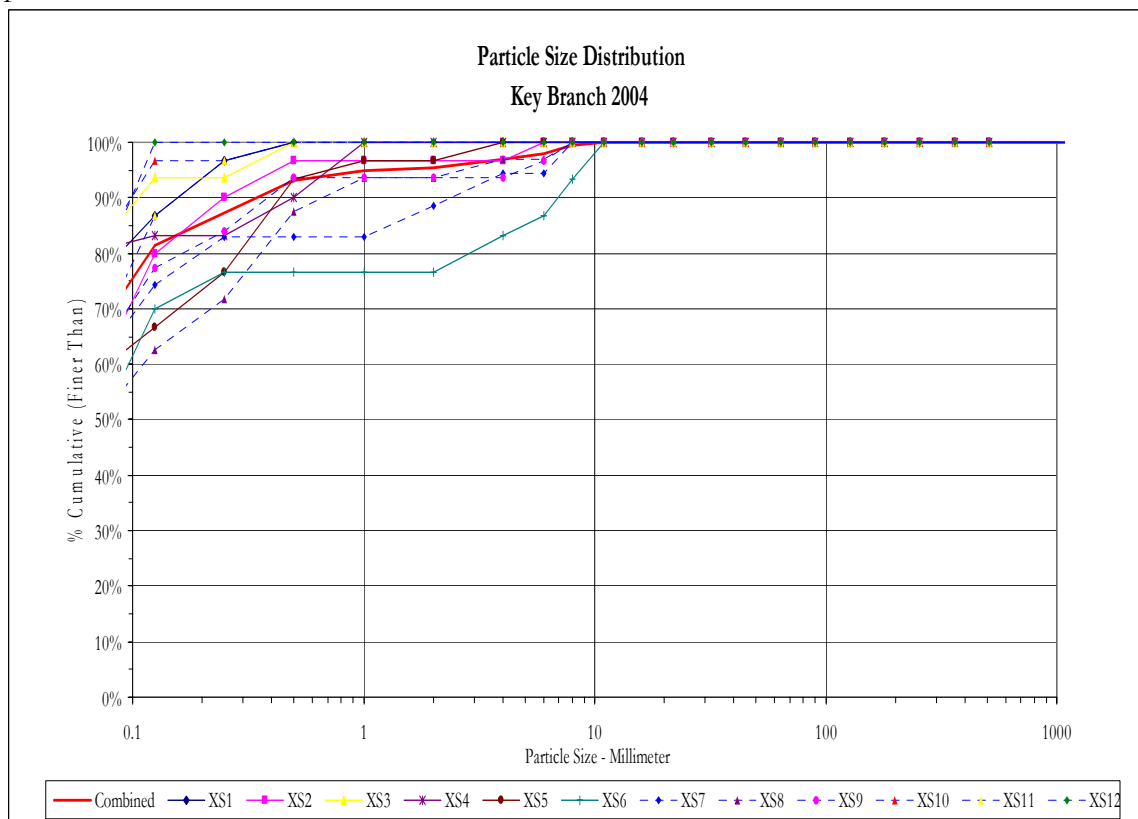
- ◆ Cross Section #1. Key Branch, Station 13+99, midpoint of glide
- ◆ Cross Section #2. Key Branch, Station 18+00, midpoint of run
- ◆ Cross Section #3. Key Branch, Station 22+00, midpoint of pool
- ◆ Cross Section #4. Key Branch, Station 26+00, midpoint of pool
- ◆ Cross Section #5. Key Branch, Station 30+00, midpoint of riffle
- ◆ Cross Section #6. Key Branch, Station 34+00, midpoint of glide
- ◆ Cross Section #7. Key Branch, Station 38+00, midpoint of run
- ◆ Cross Section #8. Key Branch, Station 42+00, midpoint of pool
- ◆ Cross Section #9. Key Branch, Station 46+00, midpoint of glide
- ◆ Cross Section #10. Key Branch, Station 50+00, midpoint of riffle/run
- ◆ Cross Section #11. Key Branch, Station 54+00, midpoint of run

◆ Cross Section #12. Key Branch, Station 58+00, midpoint of riffle

Based on morphological design criteria and Year 2004 monitoring data, all twelve cross sections appear stable with little or no active bank erosion. Graphs of the cross sections are presented in Appendix A. Future survey data will vary depending on actual location of rod placement and alignment, however, this information should remain similar in appearance.

Pebble counts were taken at each cross section as a means to determine the bed material at each cross section location. However, only pebble counts taken at riffle sections can be utilized to classify the stream. The pebble counts taken during the Year 2004 monitoring period noted that the D_{50} (50 percent of the sampled population is equal to or finer than the representative particle diameter) for the riffle sections of Key Branch was less than 0.062 mm approximately, which is indicative of a silt/clay-bed stream.

A chart depicting the particle size distributions for Key Branch for the Year 2004 is presented below.



A longitudinal profile survey was conducted along Key Branch. Bank stability and overall condition of the site were assessed during the cross section and longitudinal profile surveys. Three areas of concern were observed in 2004. Descriptions and evaluations of these areas are as follows:

- ◆ A beaver impoundment (approximately 150 feet from the end of the site) has caused a large pond to form at the lower end of the reach. The impoundment has also

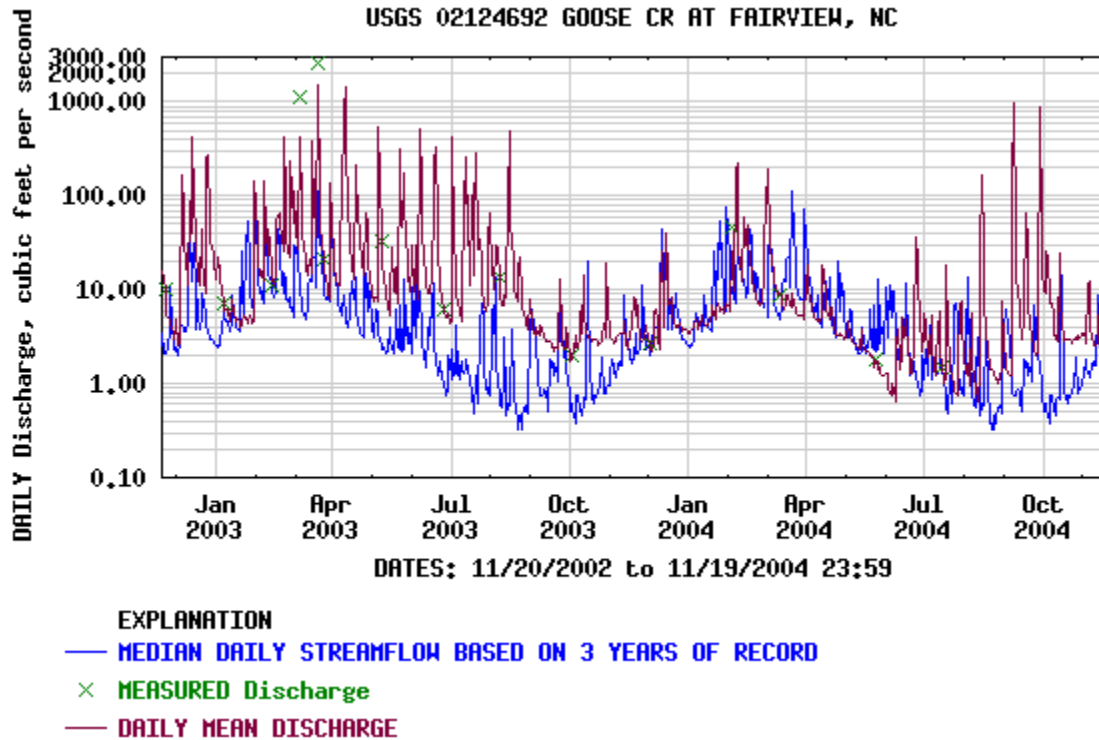
caused water to back up throughout the reach. The high water level has resulted in the stream not functioning according to designs.

- ◆ Numerous live stakes were noted within the wetted parameter of the channel. This is a result of the high water levels at the site.
- ◆ Erosion along the stream banks has caused rootwad revetments to extend into the center of the channel. Increased establishment of vegetation should stabilize the banks and cause less erosion.

2.3.2 Climatic Data

Monitoring requirements state that at least two bankfull events must be documented through the five-year monitoring period. No U.S. Geological Survey (USGS) surface water gages exist on Key Branch. A review of known USGS surface water gages identified only one gage within 25 miles (40 kilometers) of the mitigation site. The gage is located 10 miles (16 kilometers) southwest of Locust, NC and 11 miles (18 kilometers) north of Monroe, NC near Fairview Crossroads. The gage is located along U.S. Route 601 at the Goose Creek crossing.

The Goose Creek gage was utilized for this report since it is the closest and most comparable active gage station located in the Yadkin-Pee Dee River Basin. The Goose Creek Gaging Station has a drainage area of 24 square miles. It is situated in USGS Hydrologic Unit 03040105. Datum of the gage is 460.0 feet above sea level NGVD29. Based on the drainage area associated with the gage, the correlated bankfull discharge according to the NC Rural Piedmont Regional Curves (USACE, 2003) is approximately 900 cubic feet per second (cfs). A review of peak flows was conducted for the period between November 2002 and November 2004. According to the graph, there were three bankfull events that occurred during this period, one of which was in September 2004. The USGS graph depicting these peak flows is presented below.



3.0 OVERALL CONCLUSIONS

The Key Branch Site has met the required stream monitoring protocols for the first formal year of monitoring. Some areas of concern existed in 2004; however, these areas are primarily a result of high water conditions due to a beaver impoundment. NCDOT is currently in contact with the USDA to remove the impoundment and relocate the beavers. NCDOT will continue monitoring in 2005.

Based on information obtained from the USGS, the Key Branch Site has not yet met the required hydrologic monitoring protocol of two bankfull events; however, four more years of monitoring remain. Wetland and vegetative monitoring is being conducted on site. That data is not contained in this report and will be submitted separately by NCDOT. Biological monitoring is not being conducted as part of this monitoring project.

4.0 REFERENCES

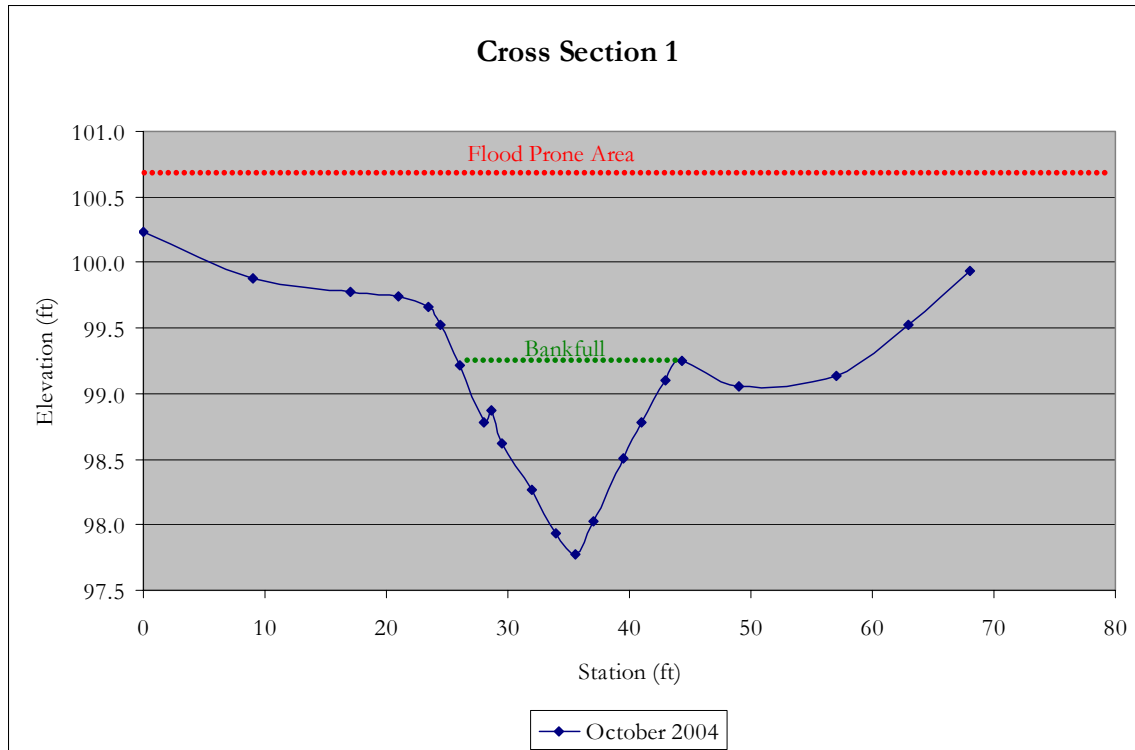
- North Carolina Department of Transportation (NCDOT), 2001. Mitigation Report for the Key Branch Mitigation Site, Anson County, North Carolina.
- Rosgen, D.L, 1996. Applied River Morphology. Wildland Hydrology, Pagosa Springs, Colorado.

US Army Corps of Engineers (USACE), 2003. Stream Mitigation Guidelines. Prepared with cooperation from the US Environmental Protection Agency, NC Wildlife Resources Commission, and the NC Division of Water Quality.

US Geological Survey (USGS), 2004. Real-time Data for USGS 02124692 Goose Creek near Fairview, NC. <http://waterdata.usgs.gov/nc/nwis>.

APPENDIX A

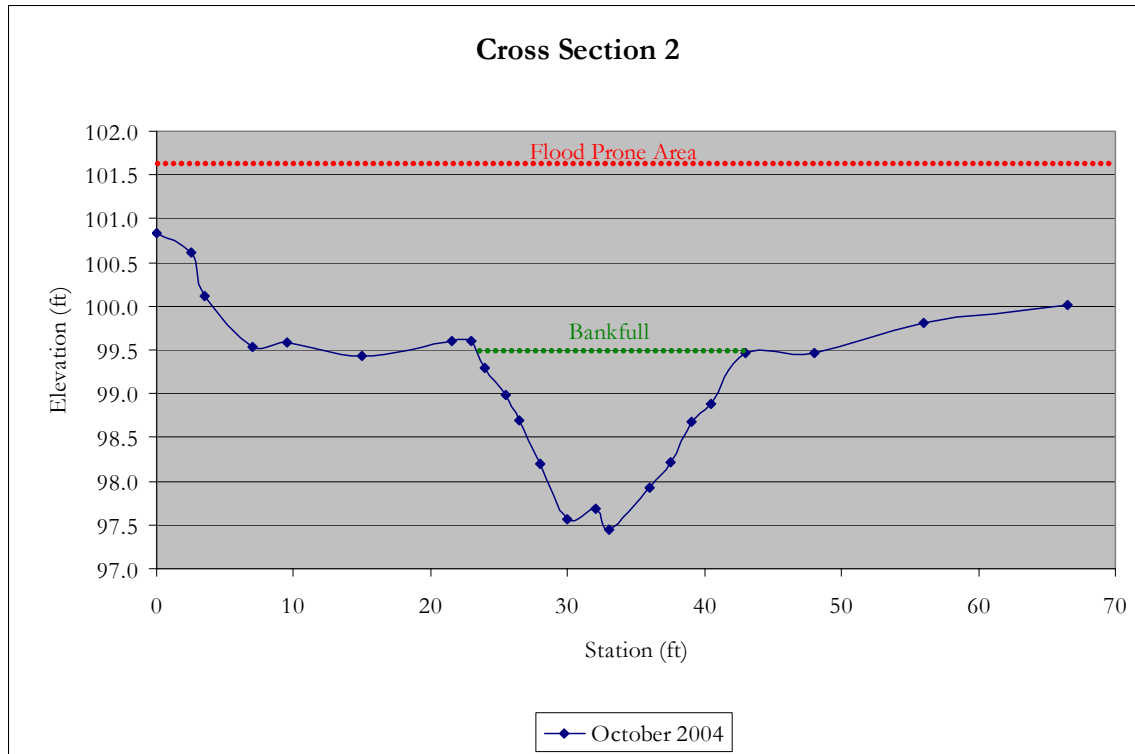
CROSS SECTIONS AND THE LONGITUDINAL PROFILE COMPARISON



Cross-Section #1 (Glide) Abbreviated Morphological Summary

	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft ²)	13.0				
Maximum Bankfull Depth (ft)	1.5				
Width of the Floodprone Area (ft)	150				
Bankfull Mean Depth (ft)	0.7				
Width/Depth Ratio	26.6				
Entrenchment Ratio	>5				
Bankfull Width (ft)	18.6				

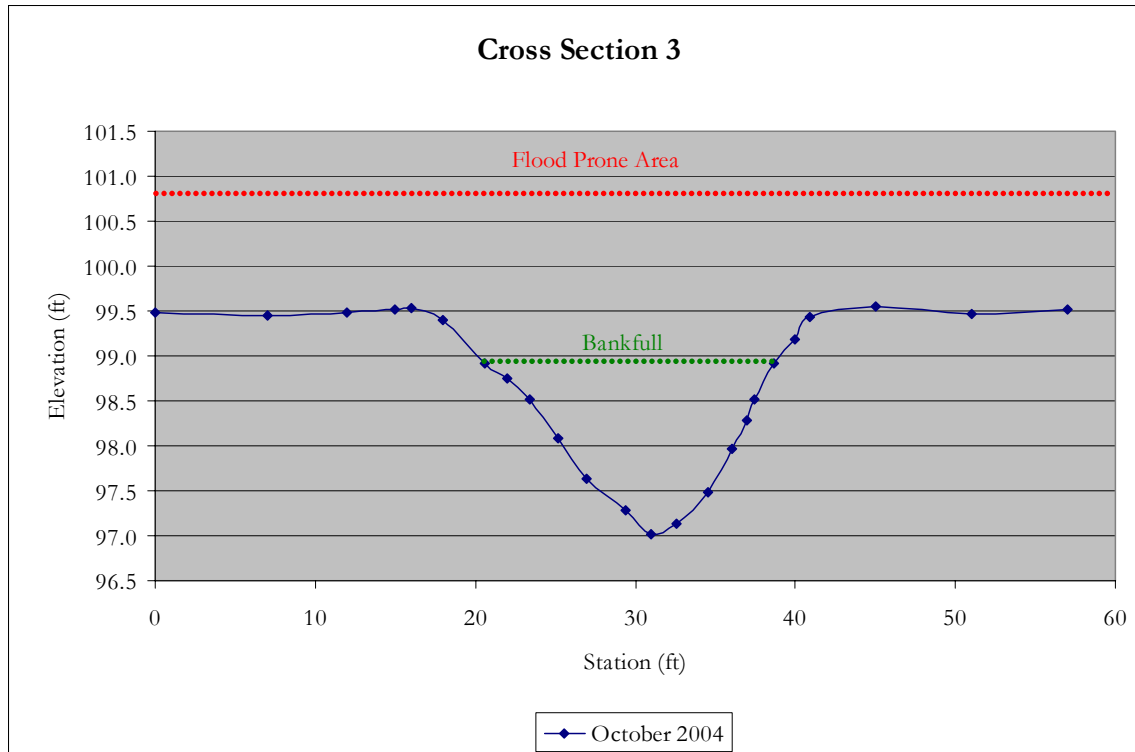




Cross-Section #2 (Run) Abbreviated Morphological Summary

	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft ²)	22.2				
Maximum Bankfull Depth (ft)	2.0				
Width of the Floodprone Area (ft)	150				
Bankfull Mean Depth (ft)	1.1				
Width/Depth Ratio	18.4				
Entrenchment Ratio	>5				
Bankfull Width (ft)	20.2				

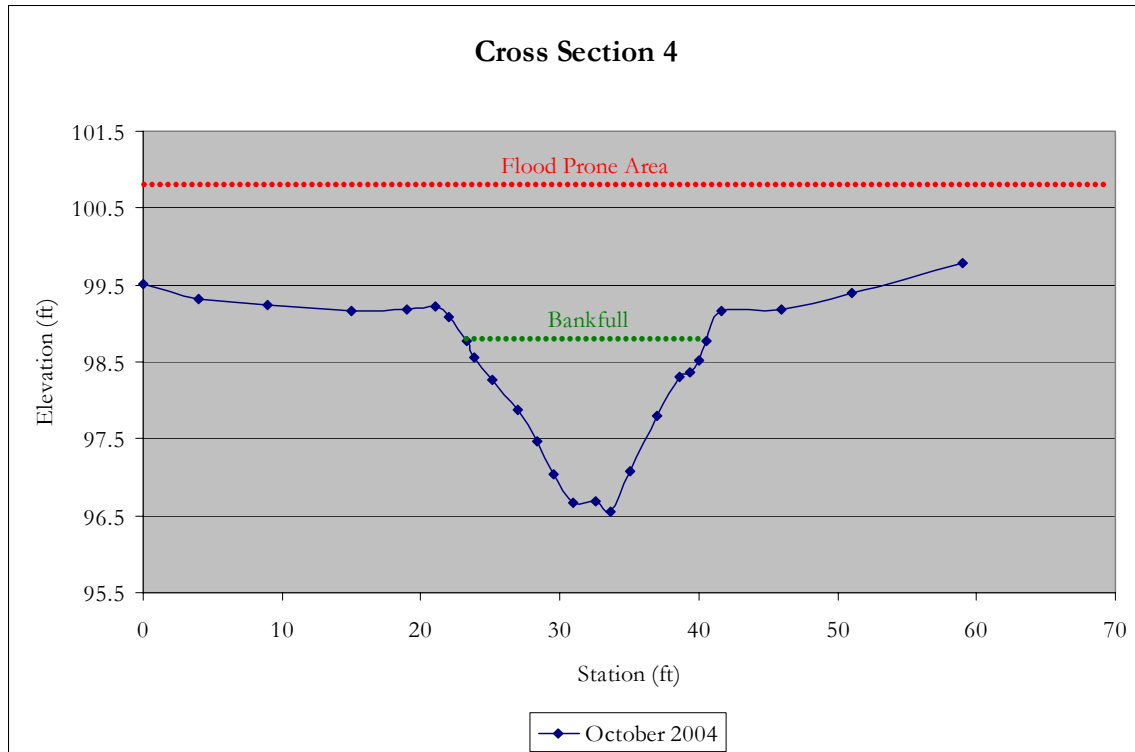




Cross-Section #3 (Pool) Abbreviated Morphological Summary

	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft ²)	18.1				
Maximum Bankfull Depth (ft)	1.9				
Width of the Floodprone Area (ft)	150				
Bankfull Mean Depth (ft)	1.0				
Width/Depth Ratio	18.1				
Entrenchment Ratio	>5				
Bankfull Width (ft)	18.1				

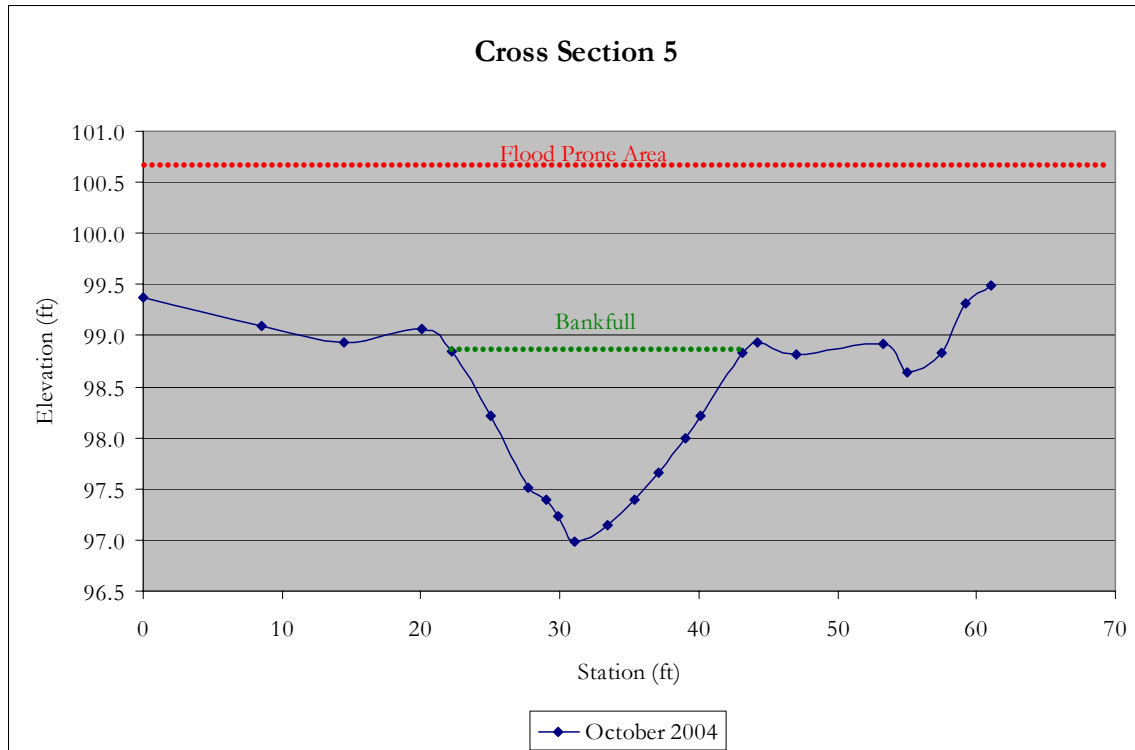




Cross-Section #4 (Pool) Abbreviated Morphological Summary

	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft ²)	20.8				
Maximum Bankfull Depth (ft)	2.2				
Width of the Floodprone Area (ft)	150				
Bankfull Mean Depth (ft)	1.2				
Width/Depth Ratio	14.4				
Entrenchment Ratio	>5				
Bankfull Width (ft)	17.3				

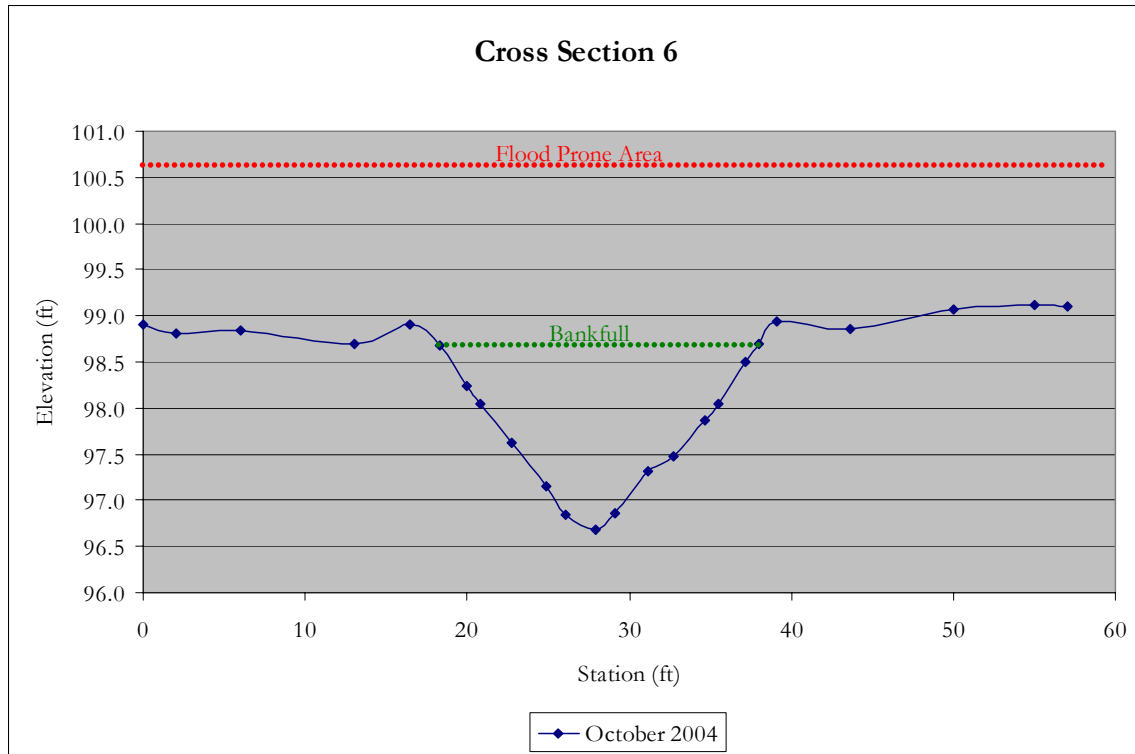




Cross-Section #5 (Riffle) Abbreviated Morphological Summary

	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft ²)	20.9				
Maximum Bankfull Depth (ft)	1.8				
Width of the Floodprone Area (ft)	150				
Bankfull Mean Depth (ft)	1.0				
Width/Depth Ratio	20.9				
Entrenchment Ratio	>5				
Bankfull Width (ft)	20.9				

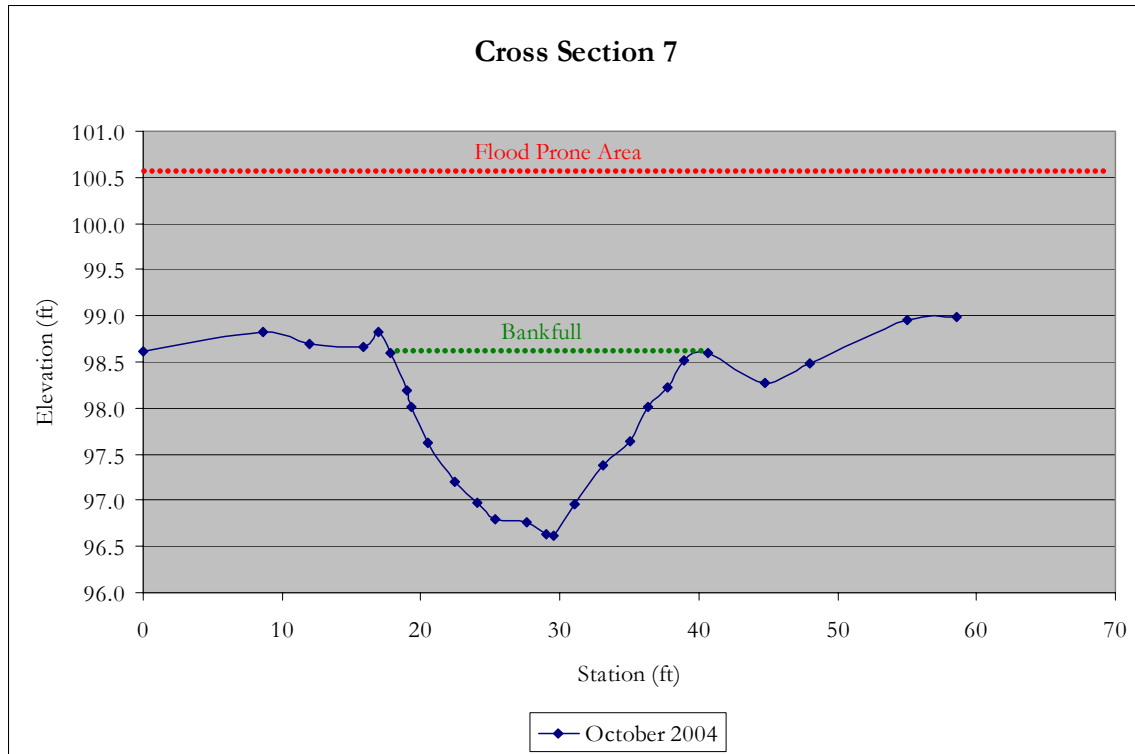




Cross-Section #6 (Glide) Abbreviated Morphological Summary

	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft ²)	21.7				
Maximum Bankfull Depth (ft)	2.0				
Width of the Floodprone Area (ft)	150				
Bankfull Mean Depth (ft)	1.1				
Width/Depth Ratio	17.9				
Entrenchment Ratio	>5				
Bankfull Width (ft)	19.7				

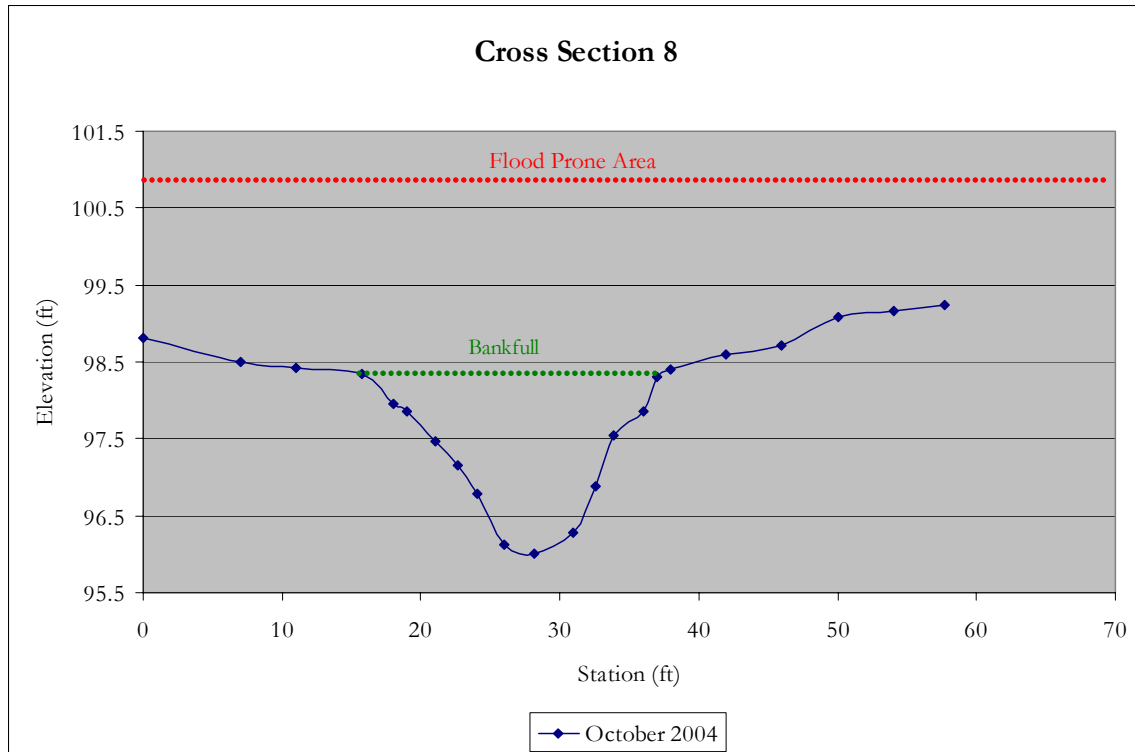




Cross-Section #7 (Run) Abbreviated Morphological Summary

	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft ²)	25.2				
Maximum Bankfull Depth (ft)	2.0				
Width of the Floodprone Area (ft)	150				
Bankfull Mean Depth (ft)	1.1				
Width/Depth Ratio	20.8				
Entrenchment Ratio	>5				
Bankfull Width (ft)	22.9				

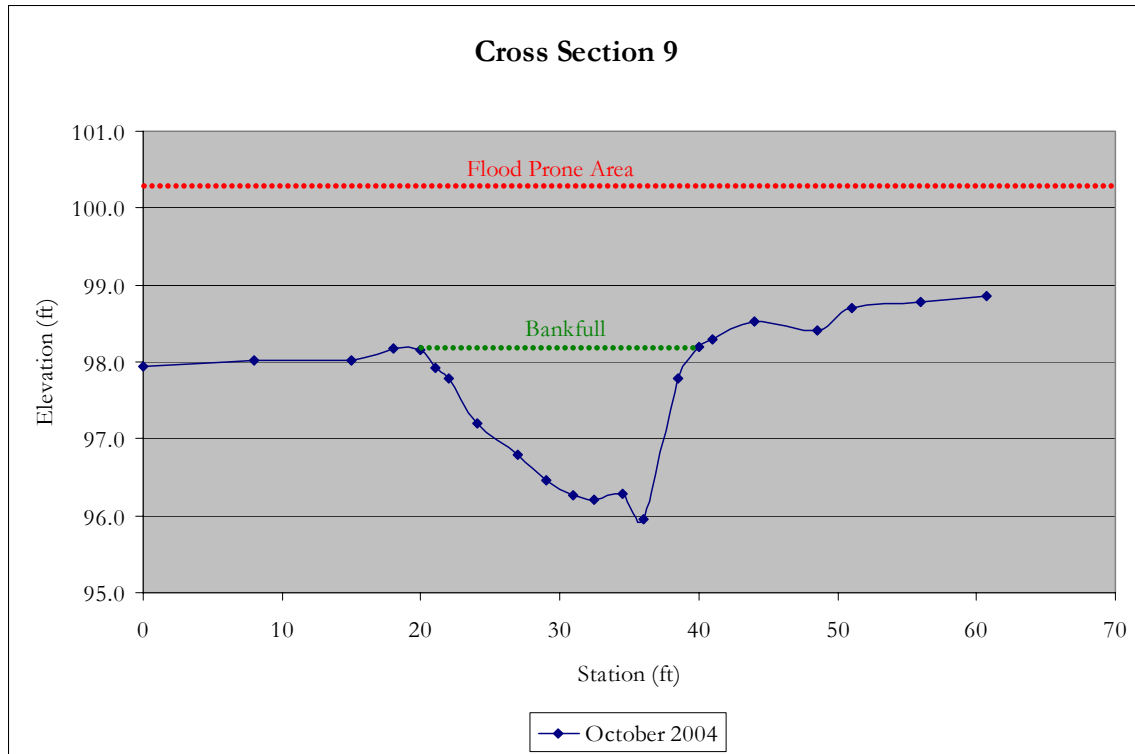




Cross-Section #8 (Pool) Abbreviated Morphological Summary

	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft ²)	25.9				
Maximum Bankfull Depth (ft)	2.3				
Width of the Floodprone Area (ft)	150				
Bankfull Mean Depth (ft)	1.2				
Width/Depth Ratio	18.0				
Entrenchment Ratio	>5				
Bankfull Width (ft)	21.6				

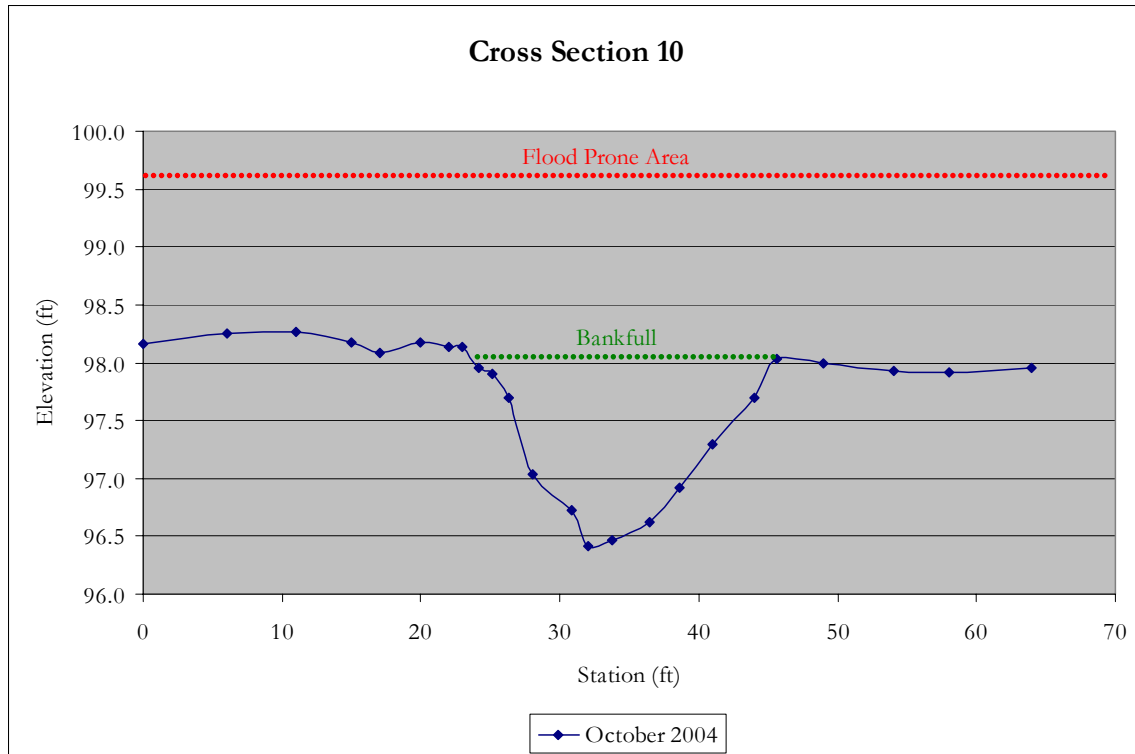




Cross-Section #9 (Glide) Abbreviated Morphological Summary

	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft ²)	26.0				
Maximum Bankfull Depth (ft)	2.2				
Width of the Floodprone Area (ft)	150				
Bankfull Mean Depth (ft)	1.3				
Width/Depth Ratio	15.4				
Entrenchment Ratio	>5				
Bankfull Width (ft)	20.0				

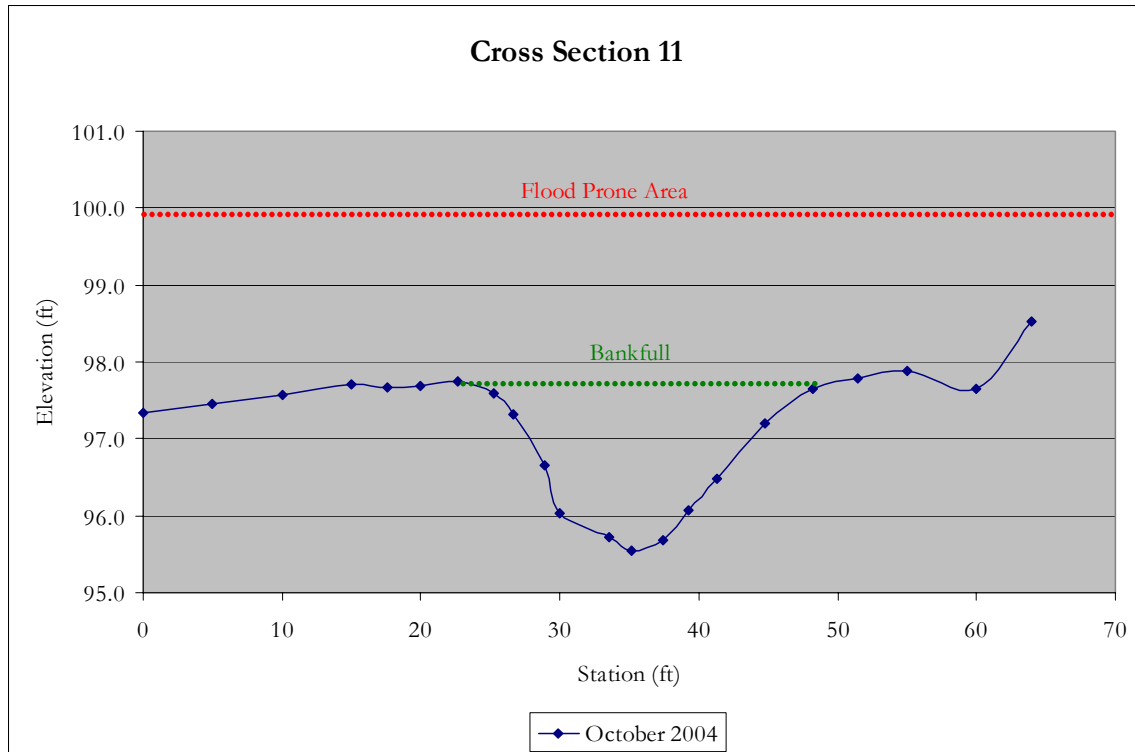




Cross-Section #10 (Rifle/Run) Abbreviated Morphological Summary

	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft ²)	19.0				
Maximum Bankfull Depth (ft)	1.6				
Width of the Floodprone Area (ft)	150				
Bankfull Mean Depth (ft)	0.9				
Width/Depth Ratio	23.4				
Entrenchment Ratio	>5				
Bankfull Width (ft)	21.1				





Cross-Section #11 (Run) Abbreviated Morphological Summary

	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft ²)	30.4				
Maximum Bankfull Depth (ft)	2.2				
Width of the Floodprone Area (ft)	150				
Bankfull Mean Depth (ft)	1.1				
Width/Depth Ratio	25.1				
Entrenchment Ratio	>5				
Bankfull Width (ft)	27.6				



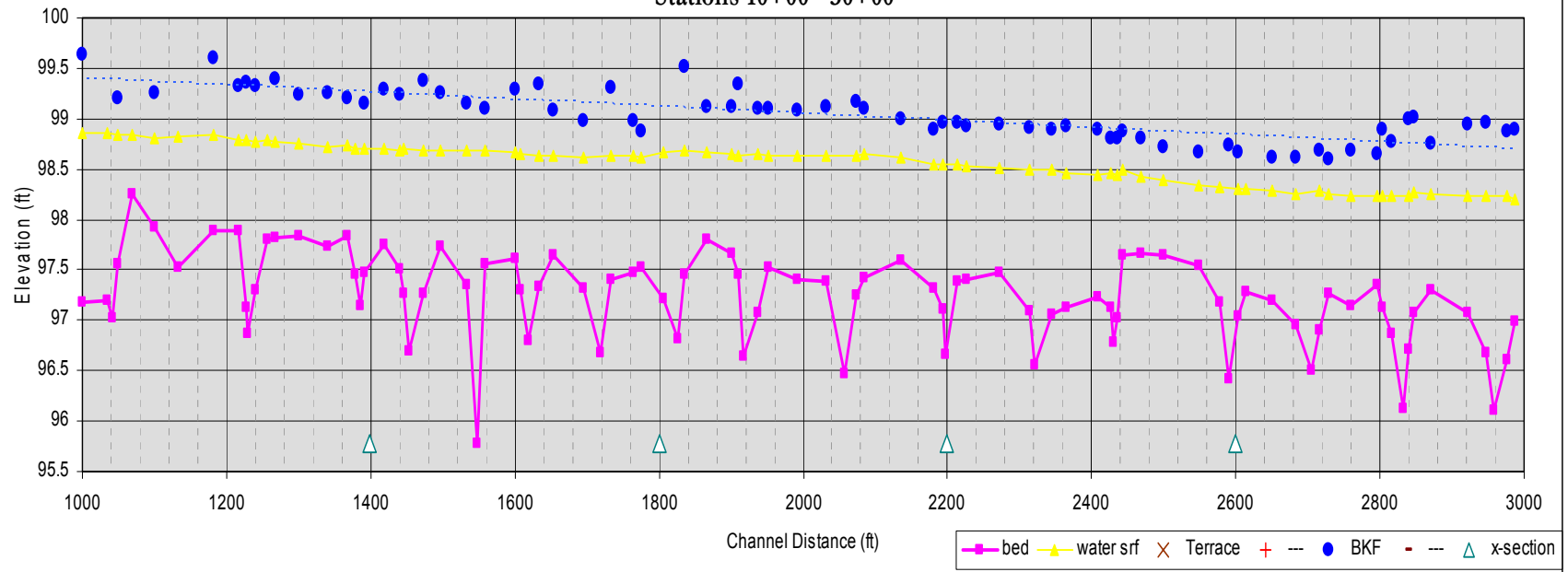


Cross-Section #12 (Rifle) Abbreviated Morphological Summary

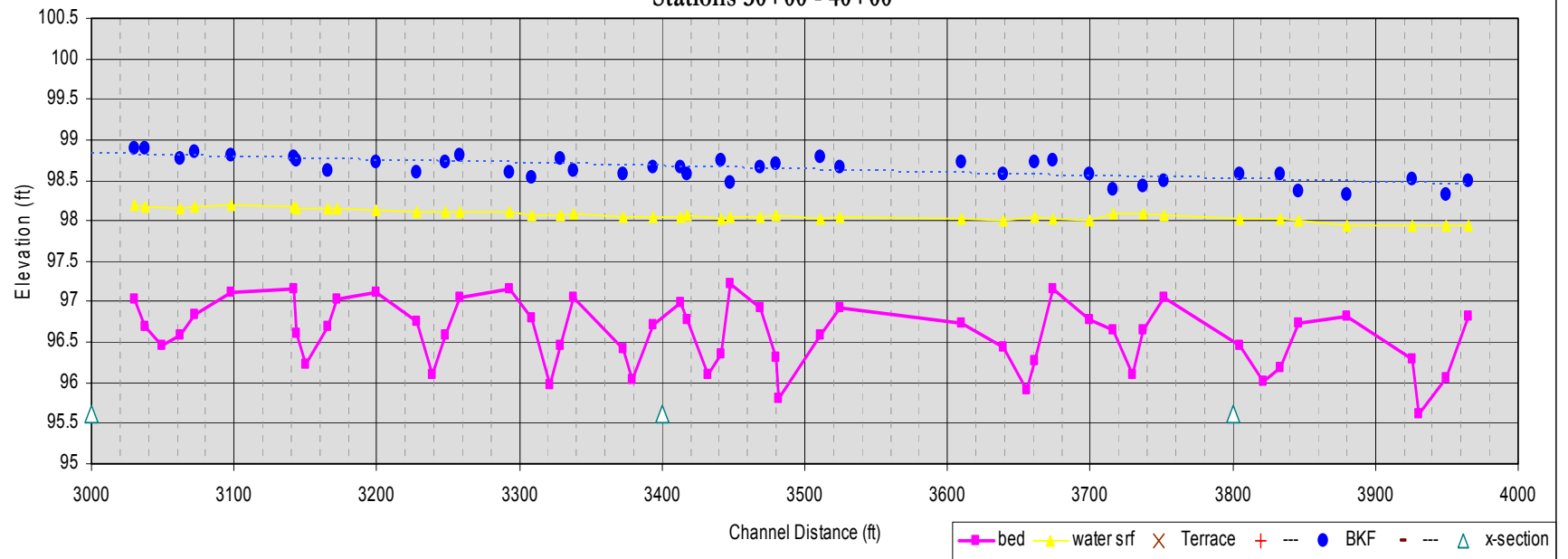
	2004	2005	2006	2007	2008
Bankfull Cross Sectional Area (ft ²)	26.9				
Maximum Bankfull Depth (ft)	2.1				
Width of the Floodprone Area (ft)	150				
Bankfull Mean Depth (ft)	1.0				
Width/Depth Ratio	26.9				
Entrenchment Ratio	>5				
Bankfull Width (ft)	26.9				



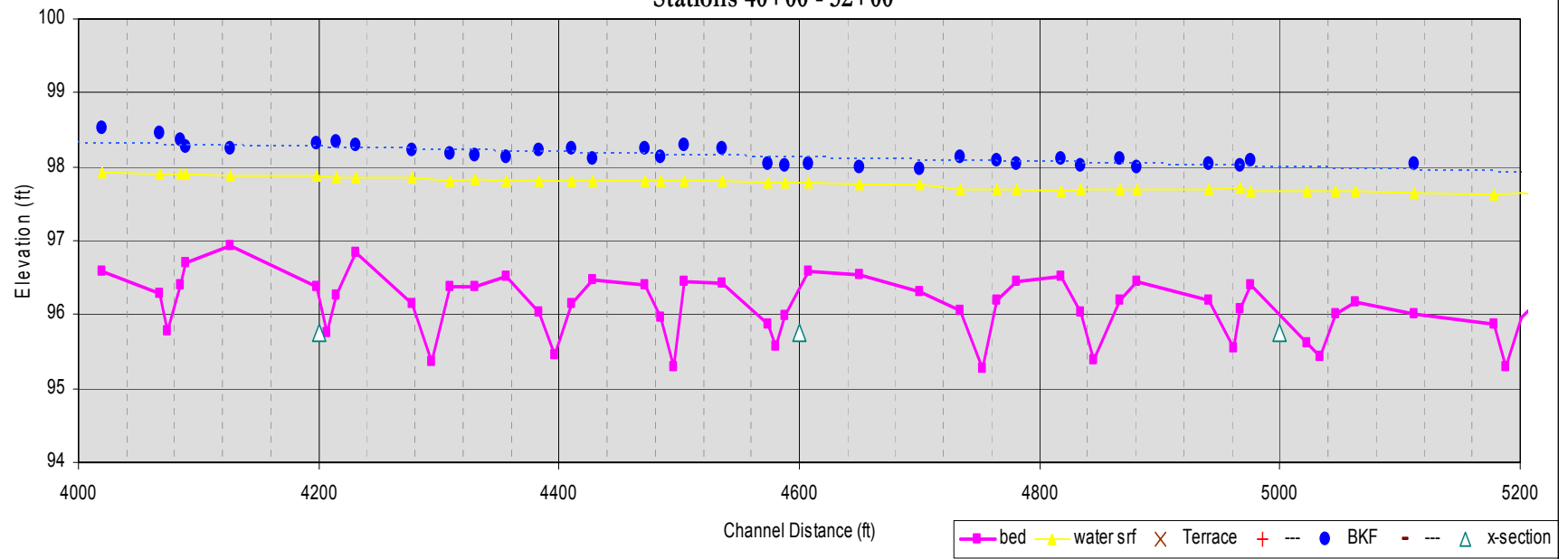
Key Branch Longitudinal Profile 2004
Stations 10+00 - 30+00



Key Branch Longitudinal Profile 2004
Stations 30+00 - 40+00



Key Branch Longitudinal Profile 2004
Stations 40+00 - 52+00



APPENDIX B
SITE PHOTOGRAPHS

Key Branch Photographs



Photo Point #1 Looking Upstream



Photo Point #1 Looking Downstream



Photo Point #2 Looking Upstream



Photo Point #2 Looking Downstream



Photo Point #3 Looking Upstream



Photo Point #3 Looking Downstream

Key Branch Photographs (continued)



Photo Point #4 Looking Upstream



Photo Point #4 Looking Downstream



Photo Point #5 Looking Upstream



Photo Point #5 Looking Downstream



Photo Point #6 Looking Upstream



Photo Point #6 Looking Downstream

Key Branch Photographs (continued)



Photo Point #7 Looking Upstream



Photo Point #7 Looking Downstream

Additional Photographs



Beaver dam at lower end of reach



Pond upstream of beaver dam



Rootwad extending into channel near
Cross Section #9



Live stakes under water due to channel
widening